**Ozone Standard Reference Photometer**

**Optical bench schematic**

Realisation of the measurement equation:
- \( P_{\text{in}} \) and \( P_{\text{out}} \) are measured in cell #1
- \( l \) is the length of the cells
- \( D \) is deduced from the frequencies \( f_1 \) and \( f_2 \) in two half-cycles

**Measurement principle: the Lambert-Beer law**

The measurement equation is derived from the Lambert-Beer and ideal gas laws. The number concentration (C) of ozone is calculated from:

\[
C = \frac{1}{l} \frac{P_{\text{in}}}{P_{\text{out}}} (\ln(D))
\]

where:
- \( D \) is the absorption cross-section of ozone at 253.7 nm in standard conditions of temperature and pressure
- \( l \) is the optical pathlength of one of the cells
- \( T_{\text{in}} \) is the temperature measured in the cell
- \( T_{\text{std}} \) is the standard temperature (273.15 K)
- \( P_{\text{in}} \) is the pressure measured in the cells
- \( P_{\text{std}} \) is the standard pressure (101.325 kPa)
- \( D \) is the product of transmittances of two cells

**Standard Reference Photometer**

The ozone Standard Reference Photometer is used to calibrate ozone analysers in the range 0.2 - 1000 nmol/mol of ozone in dry air. It contains an ozone generator to deliver the same ozone concentration to its photometer part (optical bench) and to the different mole fractions over the required range, and measuring these with the photometers. The comparability of the two instruments is evaluated with a linear regression fit performed on the two sets of measured ozone mole fractions.

**Ozone production**

The very reactive nature of ozone precludes its storage in cylinders. As a consequence, ozone has to be produced and measured simultaneously. Each SRP system includes an ozone generator. This generator is based on the photolysis of \( O_2 \) molecules contained in pure air using radiation at 185 nm.

**Ozone absorption cross-section value at 253.7 nm**

The ozone absorption cross-section at 253.7 nm has been measured at least 12 times since 1953. The uncertainty of 1.5% at 95% level of confidence.

**The two cells principle in details**

The measurement of one ozone concentration in the SRP is performed in two half-cycles with an inversion of the two cells roles.

First half-cycle: the ozone sample is injected in cell #2

Second half-cycle: the ozone sample is injected in cell #1

If the ratio \( D \) is defined as:

\[
D = e^{-\alpha l_1} e^{-\alpha l_2} = e^{-\alpha (l_1+l_2)} \times \text{Transmittance of a cell of length } l_1
\]

- The light path length is two times one cell length, improving the instrument resolution (0.20 nmol/mol).
- The use of two gas cells overcome the instabilities coming from the light source.

**Optical bench**

Electronic module

**The absorption cross-section is wavelength dependent**

The absorption cross-section is wavelength dependent.

**Ozone absorption cross-section measured in standard conditions of pressure and temperature**

Max at 253 nm

**Ozone absorption cross-section value at 253.7 nm**

The ozone absorption cross-section at 253.7 nm has been measured at least 12 times since 1953. The conventional value recommended by the ISO standard 13964 is: \( 1.147 \times 10^{-17} \text{ cm}^2/\text{molecule} \) with an associated uncertainty of 1.5% at 95% level of confidence.